THE TELEGRAPHIC JOURNAL.

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PROFESSOR ABEL'S ADDRESS.

WE would invite the attention of our readers to the address delivered to the members of the Society of Telegraph Engineers by their new President, Professor Abel, at the opening meeting, on the evening of Wednesday, the 24th ult., the first part of which will be found in another portion of this Journal. Assuming that the honour conferred upon him was intended by the Society to be more an acknowledgment of the great importance to the telegraph engineer of Chemical Science, with which his name is so intimately connected, than as a recognition of any special claims of his own, Professor Abel took as the theme of his address the aid which Chemistry had brought to telegraphic science in the past, and the signal advantages which a proper application of it might bring to the solution of future problems. No better illustration of what chemistry had done for telegraphy could have been adduced than that which was brought forward in the labours of the late Dr. Matthiessen. His researches into the causes of the difference in the electrical conductivity of copper, followed by his exposition of the principal factors governing it, may well be said to have inaugurated a new era in the history of submarine telegraphy. As a practical outcome of the work done by the chemist in the same direction, with reference to the manufacture of iron and steel wire, it is sufficient to mention that the Government, having in consequence raised the standard of that used for telegraph purposes, experienced no difficulty in receiving from the manufacturers wire which satisfied all the conditions insisted upon.

Hardly less important to telegraphy than Matthiessen's labours were Professor Miller's investigations into the causes of decay of gutta-percha and india-rubber; and although it cannot yet be said that the same state of perfection has been reached with the dielectrics as with the conductors of cable, still no words are required to show the good work done by Chemistry in this branch, and how, by clearly indicating the causes of failure in the past, as well as foreshadowing a likely field for experiment in the future, Chemical Science has laid the foundation for the perfect insulator.

The question of Batteries needs but to be named, and the value of Chemical Science cannot fail to be recognised at once. The causes of decay, and the steps to be taken for the preservation of timber, the production of a joint to withstand the influence of time are questions which can be solved by a proper knowledge of Chemical Science, and by that alone.

For although instances may be adduced of some galvanic combination, or some method of jointing having been brought out by men to whom Chemistry was little more than a name, no argument can for a moment be based upon isolated facts of this nature; it would have been rather a subject of wonder if among the numerous hap-hazard attempts made by so many workers something of the kind had not been done.

Professors Abel's admirable address has come at a time when something of the kind was urgently wanted. So abnormal were the conditions under which the science of telegraphy sprang into existence, and so rapid has been its growth, that of all professions, that which constitutes the profession of a "telegraph engineer" would probably be the most difficult to define. The "practical" man, as he loves to term himself, who has drawn his lessons solely from his experience, and learnt his work literally by the sweat of his brow, is too apt to despise anything to which even the name of Pure Science is applied. The comparative value of a pound of theory and an ounce of practice is too often upon his lips. To him no more complete answer can be given than Professor Abel's address. On the other hand, the pure scientist is almost equally fond of running into the opposite extreme, and arrogating to himself all the progress which has been made. It is in the happy blending of both that the qualifications of the telegraph engineer ought to consist: based upon a substratum of scientific knowledge—in which chemistry should occupy the foremost position side by side with electricity itself—the practical experience of after years would have no difficulty in raising a goodly superstructure, and not the least of the many valuable lessons which may be taken to heart from Professor Abel's words, is that by the wedding of science and practice alone can the advancement of telegraphy be promoted.

The Annual General Meeting of the Physical Society will be held on the 3rd inst., at 3 p.m., when, after election of officers, &c., the following communications will be read:—"On Vortex Motions," by Prof. Osborne Reynolds; "On Apparatus to illustrate Wave Motion," by C. J. Woodward, B.Sc.

SMEE AND BAIN.

WERE it not that the death of these two electrical celebrities occurred during the same week, and was chronicled in the same number, it is probable that they would never have been associated together. The one was a highly gifted scientific man, an eminent surgeon, and a successful commercial gentleman—the other was a marvellous inventive genius, a skilful watch and clockmaker, but unfortunately, in his later years, an improvident and intemperate mechanic. The one will live in history as the father of one form of battery—the other will be remembered as the author of one of the most beautiful applications of the electrolytic effects of currents of electricity to telegraphic purposes, and the inventor of automatic telegraphy and of electric clocks.

There is a wonderful contrast between the lives of these two men. Each in his way was a genius. Smee not only made a new battery, but wrote several works on electricity—one on "Electro-Metallurgy" deserves to be classical for its erudition and clear-sightedness. It has taught many an electrician the natural history of the battery. He devised the present system of printing the Bank of England notes—the plates of which are deposited electrolytically by his own battery.

His battery, invented in 1840, when he was twenty-two, and which secured him the coveted F.R.S. when only twenty-three years of age, was a single fluid arrangement of zinc, dilute sulphuric acid and platinised silver, its chief novelty being the last, which secured mechanically the removal of the hydrogen deposited upon the negative plate by the action of the cell. In 1841 he published the results of his extensive electro-metallurgical experiments, and propounded the laws which regulate the character of the metallic deposits. This work has gone through several editions. He never applied himself to telegraphic pursuits, but he made one appearance at the Society of Telegraph Engineers, in April, 1875, when he made some very trenchant remarks on the consumption of zinc in batteries. He showed, however, that his theoretical notions had not advanced with the age.

Bain's first patent was taken out in January, 1841, when he applied currents to clocks. He showed not only how clocks could be worked without any winding, but how any number of clocks could be worked from one standard time-piece, and how uniform Greenwich time could be shown throughout the country. In December of the same year, he showed how electricity could be applied to control railway engines and carriages, by shutting off steam and opening the whistle. At the same time he invented a type-printing machine, and showed how to lay down wires two or three feet underground, in asphalte or pitch, when in a soft state. He also showed how to communicate across rivers and "bodies of natural water" without wires, and he in ignorance of Steinheil's work re-discovered the earth circuit. In 1843 he devised a method of conveying intelligence to police in fire-stations—the forerunner of numerous subsequent systems effecting the same purpose. In this year he first invented his chemical telegraph, to "take copies of surfaces—for instance, the surface of printers' types, at distant places"—in fact, his first recording telegraph was the same in principle as the last French invention of Caselli. Verily, there is nothing new under the sun! In 1844 he invented an apparatus to register the progress of ships through water and the direction of its course; to ascertain the temperature in the holds of ships, by the contact formed through the expansion of mercury; and to take soundings at sea by registering electrically on deck the descent of the lead. In 1846 he brought out his punched paper automatic system, in connection with his chemical telegraph, a system recently revived with great success in the United States. In 1847 he applied electricity to actuate musical instruments so as to play several of them simultaneously.

This is a long list of inventions, but his automatic chemical recorder is perhaps the only one that will live in history. It is very extensively used in America, and is gradually being re-introduced into England.

In 1843 his friend and fellow-countryman, Mr. Finlaison, published a very energetic pamphlet in support of his claim to be the first inventor of the electro-magnetic *printing* telegraph, and also of the electro-magnetic clock. His right to these inventions had been questioned by Wheatstone, who had previously conceived something similar. An unseemly controversy occurred, which was not very creditable to either party concerned, and the real inventor remains a *vexata questio* to the present day. It is a fact that men, unexceptionable in point of honour and probity, exercise apparently no scruples of conscience in regard to inventions and patents. If a new discovery be announced, numbers try at once to obtain this new fact in in another way, and are much aggrieved if they are not classed with or as the original discoverer. The examination of a new patent seems to excite a desire to do the same thing in another way so as to evade the first patent and secure fresh laurels. Mr. Finlaison said in 1843—"Scientific discovery is now placed in the same category as horse-dealing or shipwreck in certain districts; by some singular train of casuistry it is entirely placed out of the pale of morality, and held to be fair game, *fera naturæ*." It is not much better in 1877.

It has been stated or inferred that Bain and his inventions were neglected, and that an unsympathetic Government or world drove him to poverty and decline; but amongst other sums he received, the Electric Telegraph Company paid him £30,000 for his automatic chemical telegraph.

We have positive and negative evidence in the lives of these two men that success in life is not due alone to mental eminence or to bodily skill, but that they must be accompanied by temperance, thrift, self-reliance, and tact.

At the next meeting of the Society of Telegraph Engineers, to be held on the evening of Wednesday, the 14th inst., Mr. W. H. Preece will read a paper "On Shunts." Mr. Preece has, we understand, been engaged for some time upon experiments on the subject, the results of which will be shown during the reading of his paper.

THOMSON AND JENKIN'S AUTOMATIC CURB-SENDER.

SIMULTANEOUSLY with his invention of the mirror galvanometer in 1857, Sir William Thomson directed his attention to the problem of how to send signals through submarine cables in such a way as to diminish as far as possible the retarding effect due to the electro-static capacity of the line, the theory of which he had investigated two years before. He pointed out that the sending of currents through cables should be effected so as to make the current attain as soon as possible a strength at the receiving end sufficient to move the indicator there, and that after this the charge remaining in the cable should be removed without delay—the removal of the residual charge being effected by the application at the sending end of an electro-motive force opposite in kind to that by which the signal had been produced. This system of using two currents, one to produce the signal and the other, of opposite name and somewhat shorter duration to neutralize (as nearly as possible) the residual effect of the first, is what is known as Curb-Sending. Its object is, of course,

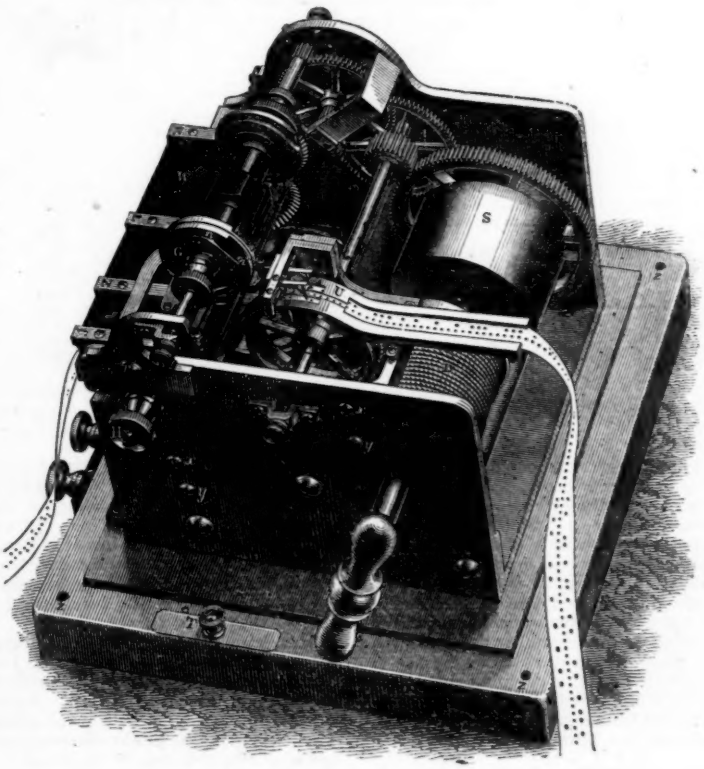

FIG. 1.

to increase the speed of signalling, and it does so by giving each signal a sharp definition, and an independence of the signals that precede and follow, which is unattainable when, as in ordinary working, each signal enters a cable already in a complicated state of charge. Simple as the principle of curb-sending is, its practical application has been found to present many difficulties. Trials have been made, but without success, to send curb-signals by means of a hand-key; the failure being no doubt due to the fact that a greater perfection of spacing is necessary than hand-sending can give. The problem has now, however, been solved, and the introduction during the past year of the Automatic Curb-Sender, under the joint patent of Sir. W. Thomson and Professor Fleeming Jenkin, is certainly one of the most important recent advances in submarine telegraphy.

Fig. 1 gives a general view of this instrument, the actual dimensions of which are about double those in the figure. The message to be transmitted is prepared beforehand by being punched on a strip of paper in right and left-hand holes corresponding to dot and dash. The paper-strip enters in front (the left-hand side in the figure)

and is carried along in the trough U by means of a toothed roller under the trough. The roller is driven by clock-work, which is kept in motion by a combined weight and spring, and its teeth enter a row of central holes in the paper. The small axle J which stands in front (and of which a separate view is given in fig. 2) also revolves, and makes one complete revolution during the passage of a

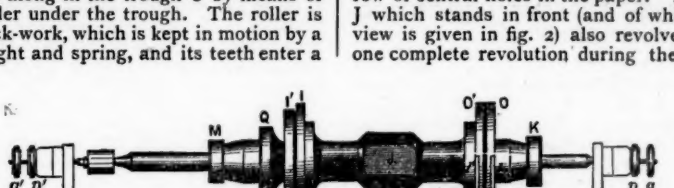

FIG. 2.

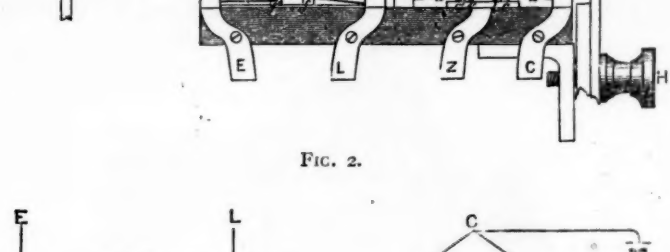

FIG. 3.

single space in the paper. Above the side-holes in the paper stand two prickers, either of which will descend whenever the corresponding hole in the paper passes below it. By its descent it raises the end of a spring *a* or *a'* (as the case may be) into the rim of a cam-wheel o o' carried by the revolving shaft J. Openings *l l'* in the rim of this wheel are passing the ends of the springs *a a'* at the same instant as the hole in the paper passes under the pricker, and thus as the pricker descends, the end of the spring *a* or *a'* can enter the rim of *o o'*, and once in is kept there during a complete revolution until the openings *l l'* come round again and allow it to drop out. But beside carrying the wheel o o' the axle J carries two cams I I' of which a side

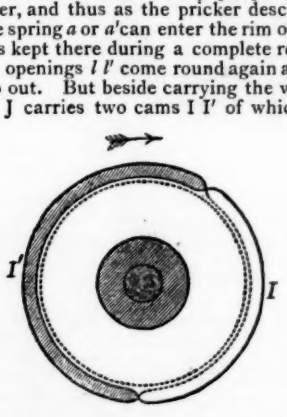

FIG. 4.

view is given in fig. 4. I' has a projecting edge extending for rather more than a semi-circle, and I has a projecting edge extending for the remainder of the circumference. While the edge of I' is passing, the spring *e'* below it is depressed so as to touch the spring *f'* while *e* is up and in contact with *g*. Then when the edge of I passes, *e'* rises so as to touch *g'* and *e* is depressed and held in contact with *f*.

The electrical changes which take place during the complete revolution of the axle J will be readily followed by comparing fig. 2 with the diagram of contacts given in fig. 3. Suppose that a "dash" or right-hand hole in the paper is passing. The corresponding pricker descends and raises the spring *a* into the rim of the wheel o through the opening *l*. The spring *a* is then kept raised, and in contact with the spring *d* during a complete revolution, while the spring *a'* remains down in contact with *c'*. But at the same instant that *a* rose, the projecting edge of I' depressed *e'*, producing the state of things shown in fig. 3, the result being that zinc is connected to line and copper to earth. This gives the signal current, which lasts until rather more than half the revolution is complete, when the projecting rim of I' has passed, allowing *e'* to rise into contact with *g'* while the rim of I comes round and puts *e* in contact with *f*; the position of the springs *a* and *a'* remains unchanged. Copper is now connected to line and zinc to earth—giving the curb-current—which lasts during the passage of I. When the rim of I

has passed the revolution is complete, the spring *a* drops out of the the rim of the wheel o, and the signal is over. All this has taken place during the passage of a single space in the paper. If, instead of a dash-hole, a dot-hole in the paper had passed, *a'* would have risen instead of *a*, and thus the signal-current would have been copper to line, and the curb-current zinc to line. It will be seen that a reversal of current takes place during every signal, the first current sent being zinc or copper to line according as *a* or *a'* has risen, but the first being always longer than the second in the proportion of the length of the projecting edge of I' to that of I. It is remarkable how near to equality this proportion should be when signals are sent fast through long cables.

In a short article like the present it is impossible to go into full descriptive details of so complicated a piece of mechanism. By an ingenious arrangement of cams on the revolving shaft J, the prickers are prevented from descending except just at the instant that the centre of a hole in the paper is beneath them, and they are instantly raised again and held up during the remainder of the revolution. This rapid dip and rise is enough to lodge the end of the corresponding spring *a* or *a'* within the rim of the wheel o o' and it prevents the prickers from touching the edges of the hole either in rising or in falling; the paper is therefore quite undamaged by its passage through the instrument, and the same strip may be passed through any number of times. By means of a centrifugal friction governor, the speed may be readily adjusted whilst the machine is running. It is interesting to observe in this as well as in several other parts of the machine the practical application of true kinematical principles of freedom and constraint—a feature of design which is one of the most prominent characteristics of all Sir W. Thomson's instruments. By aid of a "geometrical clamp" the vulcanite plate W which carries the various contact springs can be removed for clearing and fixed again exactly in the right place by a single screw H.

The punchers by which the paper is prepared are of various forms. They are conspicuous for the exactness of the spacing which they give, no matter what the speed of the punching may be. In one of them (Professor Jenkin's Power-Puncher) the heavy part of the work is done by energy stored in a wound-up spring or raised weight, and all that the operator does is to touch light finger-keys, which cause this energy to take effect. For a full description of the details both of the Automatic Sender itself and of the punchers, the reader is referred to a paper in the *Journal of the Society of Telegraph Engineers*, vol. v., 1877.

Where the limit to the speed of signalling lies, not in the skill of the operator, but in the conditions of resistance and capacity of the line, as is the case in all long submarine cables, the Automatic Curb-Sender gives a great gain in speed. Experiments made with the imitation Atlantic cable in the Laboratory of Glasgow University show this gain to be at least as great as fifty per cent. To the practical telegrapher this is only one out of many advantages which the "auto-curb" has over the hand-key. It is now widely admitted that the automatic working of telegraphs generally is not only less directly liable to mistakes than working by hand is, but has also an indirect effect in preventing mistakes by making them more easily traceable when they do occur. The benefits of automatism, already so fully appreciated in the working of land systems, have now been extended to cables; and this extension is certainly not the least of the many services which Sir W. Thomson and Professor Fleeming Jenkin have done for submarine telegraphy.

Notes.

A LECTURE on "Stephen Gray and the Discovery of Electric Conduction" was delivered at South Kensington Museum on Saturday evening, 13th ult., by Dr. Richardson. Several of the experiments made by Gray were repeated by the lecturer, and the development of the idea traced in a highly interesting manner.

The work of fitting the electric light apparatus on board the *Alexandra* is now complete. By means of this light (on the mizzen mast), it is stated that when at sea very small objects will be distinguishable some two or three miles distant.

A new method of synchronising clocks has been introduced by Messrs. Barraud and Lund, of Cornhill, who have had granted them by the Post-office authorities the special use of a system of wires for working it. A narrow slit cut in the dial of a clock admits two projecting pins. They are arranged so as to catch the minute hand at given intervals, and to set the clock to true time. The pins, attached to a pair of slotted levers, connect with an electro-magnet. The mechanism required can easily be screwed into its place, and it remains entirely disconnected from the works of the clock. Any number of clocks varying in size and calibre can, on receipt of one time signal, be simultaneously set to accord with each other in accurately denoting Greenwich time. The Bankers' Clearing House immediately availed themselves of the advantages of a system, which will remove the often-recurring disputes as to "paying in" within the specified time. Other City Establishments will be provided with the apparatus as soon as the Post-office employés are enabled to extend the requisite facilities. The invention must prove a great boon for all mercantile men, and for railway travellers, &c.

At a recent meeting of the French Academy M. Archereau presented a new kind of carbon points for the electric light. They consist of agglomerated and compressed carbon mixed with magnesia; and according to M. Archereau they both render the light more stable, and increase

its illuminating power, as compared with retort carbon points, in the ratio of 1·34 to 1. These carbon points are extremely hard, and burn without residue. They have been tried with the electric light produced by machines of the Alliance Company.

The Postmaster-General has issued notice that on and after the 1st February, telegrams for banks, counting-houses, offices, and other places of business in the City of London, which may arrive on Sundays and after 8 p.m. on week-days, will not be delivered until the following morning, unless a request be made in writing by the addresser that such telegrams may be delivered immediately on their arrival.

The laying of cables betweeen Halle-Leipzic, Halle-Cassel-Frankfort-Mayence, Berlin-Hamburg and Hamburg-Kiel, is to be commenced, we learn from the *Magdeburg Zeitung*, as soon as the ground is free of frost. The firms of Siemens and Halske, in Berlin, and Felten and Guillaume, in Cologne, are engaged in preparation of the cables. The laying will proceed much more easily than in the case of the Halle-Berlin cable. Dr. Siemens has devised a machine which makes the trench, and deposits the cable, and it is only necessary that a gang of workmen follow to fill in the trench. Siemens' machine will be used on those stretches of road where the making of the trench is not hindered by underground rock; in the latter case dynamite blasts are necessary. The cables are to lie one metre deep; the bottom of the trench must be of equal depth throughout, that the cable may be secure, and this is effected by the machine. The laying will be easiest between Berlin, Hamburg, and Kiel, the ground being here uniformly sandy and clayey. The Cassel-Mayence stretch will require much more labour and be more costly. The cost, however, has been carefully estimated. As the work of laying is to begin at several points at the same time, the work may be completed by the beginning of the hot season; it is anticipated, at least, that all the cables will be at work by September. The Halle-Berlin cable is giving every satisfaction, and the experience with it has materially conduced to an extension of the system.

Melbourne papers recently received contain some further correspondence in reference to additional telegraphic communication with Europe, Mr. Audley Coote, on behalf of Messrs. Siemens and the Anglo-Australian Company, advocating a line either from Western Australia or Northern Queensland, direct to a British settlement, either at Singapore or in India, so as to obviate all connection with a foreign country. Mr. Cracknell, the director of the New South Wales Telegraphs, had written from England in support of the Java route.

Some experiments have been been lately made by M. Holtz as to what velocity the influence-machines might be worked up to. The ebonite disc in the machine he used was 150mm. diameter, and he found, to his surprise, that even with a velocity of 125 revolutions in a second, there was no decrease in the action. From the constantly-increasing self-discharges of a small jar, it might rather be inferred that the quantity of electricity increased constantly with the velocity of rotation; so that at length it came to be about equal to that of a disc 520mm. in diameter, rotating in the ordinary way. The passage of electricity between insulator and point may therefore be regarded as almost instantaneous; otherwise the charge and discharge at so great a velocity would suffer interruption. And for an influence-machine of good construction it may be affirmed in general, that there is no maximum of velocity, at least, none such as might be produced by the passage between point and insulator.

When Prof. Hughes was residing in the United States, he was associated with Mr. Phelps, who introduced various modifications into Hughes' original apparatus. In 1858 Prof. Hughes came to Europe, and Mr. Phelps continued to devise improvements, so that after a series of transformations, the printing apparatus has taken quite a distinct form. What specially characterises the Phelps' apparatus is the replacement of the chariot by a horizontal cylinder, the vertical arrangement of the axis of the type-wheel, and of the wheels in general, and, lastly, the substitution of a pretty heavy fly-wheel for the synchronic spring. According to the American journals, the velocity of rotation, and, consequently, the rapidity of transmission, is considerably greater in the Phelps apparatus than in the Hughes, 190 turns per minute instead of 130; and in America the one apparatus is said to have quite supplanted the other.

We learn from the *Journal of the Telegraph* that Phelps's motor-printer has been for some time in successful operation between New York and Washington, in connection with Mr. Gerritt Smith's improved Quadruplex; only two instruments at each end, however, being worked at present, for the transmission and reception of messages; the other two sides of the Quadruplex being simply used for breaking or signalling. With these instruments connected by a single wire, 110 words per minute are transmitted in

the ordinary course of business. If the business should require it, two more instruments can be connected on the same wire, thus enabling the operators to transmit 220 words per minute upon a single wire, each operator sending at the ordinary rate of 55 words per minute.

The Anglo-American Telegraph Company's 1866 cable was broken on the 13th ult; the fault estimated to be about 130 miles from Heart's Content. The remaining three cables of the Company are stated to be in perfect working order and condition, so that the due transmission of messages is not affected either in speed or efficiency. This was the oldest transalantic wire at work, the cable of 1865 having not yet been recovered.

The cable between Falmouth and Lisbon has been repaired.

The remarkable induction coil recently constructed for Mr. Spottiswoode for Mr. Apps, and which gives a spark 42 inches in length, is described in last month's number of the *Philosophical Magazine*. We note that it has two primaries, either of which can be used at pleasure (for long or for short sparks). The one is of ·096-inch copper wire and 660 yards in length; it has 1,344 turns wound singly in 6 layers. The other primary is 504 yards long, wound in double strand, forming three pairs of layers. The secondary consists of no less than 280 miles of wire, wound in four sections, the wire used for the central sections being somewhat thinner than those for the external section (the diameters are ·0095 in., ·0115 in., and ·0110 in. respectively). There are 341,850 turns in the secondary. The condenser required proves to be much smaller than might have been expected. It is thought that if the insulation of the ends of the secondary wire were carried further than at present, a still longer spark than 42 inches might be obtained. From effects with a 28-inch spark it is calculated that the 42-inch spark would be capable of piercing a block of flint glass 6 in. in thickness. When used for vacuum tubes the coil gives illumination of extreme brilliancy and very long duration.

A paper has recently been communicated to the Royal Society by Prof. Burdon Sanderson, the object of which is to show—(1) That the unmutilated muscle possesses electro-motive properties which have not before been correctly described; (2) that in the "muscle-cylinder" of Dubois Reymond, the electro-motive phenomena are dependent on and determined by those of the muscle, and exhibit electrical properties which, in many important respects, are inconsistent with the "law" of Dubois; (3) that the electric change consequent on excitation, and termed by Dubois "negative variation," in like manner possesses characters entirely different from those assigned to it by him; (4) that it is not true, as averred by Prof. Hermann, of Zurich, that the electrical state of muscle becomes negative during contraction as compared with the muscle at rest, but, on the contrary, that the contracting parts become positive.

We have received the first number of a new monthly Italian journal, *L'Elettricista*, devoted to electrical science. It is edited by M. Lamberto Cappanera, and contains a quantity of interesting matter by Italian *savants* and others, (the opening paper describes an electrical seismograph invented by M. Cecchi), and is handsomely illustrated. We hope to notice its contents more fully on another occasion.

Mr. Whyte, of Maryland, introduced in the United States Senate, on 16th ult., a bill to promote telegraphic communication between America and Europe. It proposes to authorise Ferdinand C. Latrobe, Wm. F. Frick and Robert Garrett, of Maryland, to lay and maintain submarine cables to connect American and European coasts, on condition that at least one cable shall be laid and operated within three years; that the tariff rates shall be as low as one shilling British currency per word, and that the cable interests thus established shall not be sold or united to, or amalgamated with any existing European or other cable companies.

City Notes.

Old Broad-street, 31st January, 1877.

THE movement which has been inaugurated by the Globe Telegraph & Trust Company, for the purpose of virtually fusing the two Atlantic Cable Companies, will be brought to an issue in the course of this week. We have had occasion to refer to this scheme in our two previous numbers, and before we again go into the merits of the present dispute we propose to consider for a moment the objects and the position of the Globe Company.

The Globe Company was originally started for the purpose of monopolising, or in other words, placing in the hands of a few men—viz., the Globe Directors—the control of all submarine cable enterprises. The preamble to its articles of association most unequivocally expresses this object in the following words:

"That which is at present contemplated as the principal object for which the Company is formed is the acquisition and amalgamation in one Company of the principal lines of submarine telegraph and the land lines used in connection therewith. It is proposed, in the first instance, to acquire the shares and other securities of the companies owning them, issuing the shares of this Company in exchange for them, or to raise funds for the purpose of paying for them, and as

opportunity offers, acquiring and absorbing the businesses and property of the companies themselves."

In addition to this, the memorandum of association of the Company, while giving it power to carry on almost any business in the world, particularly introduces the feature of the manufacturing interest into the objects of the Company. As, however, the promoters of the Company found, on trying to launch it, that this most comprehensive scheme, although pretty enough on paper, did not meet with the desired support from the public, they dressed their Company up as a simple Trust Company, and as such it has until recently existed. The idea of a Trust Company is too well known to need much explanation. Whereas the return paid by any particular Telegraph Company may be high at one time and low at another, the whole of the capital invested in telegraphic undertakings yields a pretty even income in every year. It was proposed, therefore, that the investor should, instead of buying a small quantity of one particular Stock, buy Globe Shares, and that the proceeds from such and other sales of Globe Shares should be judiciously invested in all or most of the sound and dividend-paying shares of various Telegraph Companies, so as to average dividends and risks. The same purpose was also to be effected by an exchange of Telegraph Shares for Globe Shares.

This ostensible purpose of the Company is, certainly, a good one, and it was justly anticipated that such a Company, managed by men of high standing and intimate acquaintance with telegraphic property, would show much better results than the average investor in telegraph shares could expect. That, however, the original idea of acquiring a control of all principal telegraph lines has been followed rather than the one ostensibly suggested by a Trust Company, is undoubtedly the reason for the present highly unsatisfactory condition of the Company. It might have been thought that the Directors of the Globe would be in a position to buy all the telegraph shares they wanted for their Company, if not at the lowest, at least, at fair prices in the market, not only knowing, as they did, the telegraph market well, but even making over and over again the price of telegraph shares by their own actions.

It appears, however, that for some unexplained reason or other a great many of the telegraph shares bought by the Globe were bought as dearly as they could possibly be paid for. Thus £261,000 of Anglo-American stock were acquired at an average price (as per balance sheet) of 69, whereas during the whole of the financial year in which this transaction took place, only on four days were Anglos as high or higher than 69. Why should the Globe Directors have chosen out of the three hundred and sixty-five days which a year is commonly supposed to have, one of those four when Anglos were dearest?

Thus Direct Cable Shares were obtained at a price of 11¾, and only on one day during this year were Directs as high or higher than 11¾: why again acquire on this particular day? German Unions were bought apparently on the one day when they were dearest, and Indo-Europeans on one of six days out of the year when they were dearest. So far, the transactions carried out on behalf of the Globe Company by their Directors display, to say the least, a singular want of judgment.

Looking at the whole of the Globe investments, it appears that on 18th July, 1876, the market value of the shares and stocks held by the Company was less than £2,000,000, whereas the cost to the Company of these identical securities appears to have been £2,978,029 15s. 4d. This enormous difference does not seem to indicate a triumph of the Directors' judgment.

At the present moment, the Globe Company (being "very deep in Anglos"), in connection with some well-known Stock Exchange speculators, comes forward to advise the Direct shareholders what to do with their property. Would it not be more becoming for the Globe Company to put its own property first into good order? And would it not be more modest as well as more straightforward for their Chairman, after the heavy depreciation in the market value of the Globe's investments, suffered during his presidency by his own Company, to refrain from giving lessons to another Company how to manage its affairs?

It is proposed to instruct the Directors of the Direct Company to work in a friendly alliance with the Anglo-American Company. Whatever that may mean, Mr. Pender, who has, or at all events ought to have, some knowledge about the working of telegraph companies, must know this much full well, that if two companies divide a field of telegraphic enterprise, one of whom is a younger and a smaller company, the only safeguard for its success, nay for its very existence, lies in an active and vigorous competition. Does Mr. Pender really not know that the Direct has obtained its large and remunerative traffic only because it is working absolutely independently, and that the mildest flirtation with the Anglo Company would not only deprive it of its income, but cost it its landing rights in Canada and America? Does Mr. Pender really imagine that what the public want is friendly working between the two companies furnishing the channels of telegraphic communication between the Old and the New World, with its attendant slackness of work and indifference to the public interest, and not rather a brisk competition which will try every day to better and to facilitate telegraphic intercourse? Does Mr. Pender really not know that a new company would at once be started with two cables, and that it would take as much traffic again as the Direct does now, and that the residue would then have to pay a dividend on not only Anglos but on Directs as well?

If Mr. Pender does not know all this, he had better give up telegraphy and go back to silk, and if he does know all this, after a long telegraphic career, what are we, what is the public to think of his disinterested advice to the Direct United States Company?

The Direct Company does neither want Mr. Pender's advice nor his interference, and the Anglo Company does not want him either. Both companies are fully able to take care of themselves, and if any matters are to be settled between them let them do it themselves like men and without a go-between.

And now, before dismissing this subject for the present, one word of advice to the various parties interested in this scheme. First, to you independent shareholders of the Direct Company, resist, if ye be wise, the attempt now being made to deprive you of a property which is every day increasing in value, and which, so far as human foresight can tell, must yield you a handsome return in the future. The uphill game, although a long one, has been successfully played by your management, and the vessel has been guided clear of the rocks of Scylla; do not now, when the shoals and quicksands of adversity are past, drive her by mutiny amongst yourselves into the inhospitable arms of Charybdis.

And to you shareholders of the Globe we would say: Think ye not that, after the tale which is unfolded to you, perhaps not for the first time above, it is about time to be up and stirring for the purpose of seeing that your own house is in order? Might you not, with advantage to yourselves, appoint a committee of shareholders for the purpose—to quote the words of one of your own number—of "examining the books, inquiring into and analysing all transactions having reference to the sale, purchase, or exchange from time to time of stocks and shares?" Ask your directors why they will

invariably invest in the shares of other companies only when they are at the highest value in the market? They *may* be able to explain to you, what we confess we are unable to see, the wisdom—the wisdom, so far as you and not they are concerned, of such transactions.

And finally, to you Messrs. John Pender and Co., the promoters of this scheme, whether you are successful in your present efforts or not, may not inaptly be applied with only slight modifications the prophetic words of Meg Merrilies to the Laird of Ellangowan:—"Ride your ways—ride your ways. This day have ye tried to quench smoking hearths: see if the fire in your own parlour burn the blither for that: ye have tried to tear the thatch from cottars' houses, look if your own roof-trees stand the faster. Ye may stable your stirks in the shealings at Dencleugh—see that the hare does not couch on the hearthstane of Ellangowan."

Proceedings of Societies.

PHYSICAL SOCIETY—20TH JANUARY, 1877.

Prof. G. C. FOSTER, President, in the chair.

THE following candidate was elected a member of the Society:—Mr. A. G. Greenhill, M.A.

DR. HUGGINS exhibited an enlarged view of a photograph of the spectrum of the Star α Lyræ, which he has recently taken in a manner similar to that in which the spectrum of Sirius has already been obtained. The first results were very unsatisfactory, in consequence of the clock-work being insufficient for maintaining the image of the Star on the slit for a length of time. Mr. Grubb has, however, devised a secondary control apparatus, the employment of which renders it impossible for the error to exceed one-tenth of a second. In the spectroscope employed the prism was of Iceland spar, and the lenses of quartz. Dr. Huggins has also been engaged in taking a series of photographs of the Moon, and hopes to obtain some information in regard to the question of a lunar atmosphere of small extent. In the spectrum of α Lyræ, a line occurs corresponding with H_1 in the solar spectrum, and several more refrangible ones which he is at present unable to explain.

MR. LOCKYER considers the results which Mr. Huggins is obtaining to be of extreme importance, and he pointed out how he hopes a large series of photographs of stellar spectra will afford valuable information in regard to the constitution of certain substances now supposed to be elementary, such as calcium. He considers that this metal is not a simple substance, but that the H lines are due to two elementary substances of which it is composed, and this supposition is confirmed by the fact that in the photograph exhibited by Dr. Huggins only one of the H lines is present, that is, only one of the constituents of the metal calcium is present in the Star α Lyræ.

MR. W. C. ROBERTS read a paper on the artificial production of Columnar Structure. He found as the result of experiment that when certain masses of clay and sand are heated to about 1300°C, they contract to about the same amount as a basalt does in passing from the molten to the solid state, and that beautiful columnar forms are produced. He had hoped by accumulating a number of specimens to have been able to establish a relation between the strains at the point of rupture and the dimensions of the hexagons, but in the small masses employed, the strains were so numerous that it was impossible to apportion their influences.

PROF. GUTHRIE showed an arrangement he has recently devised, in the hope of making the mercurial as sensitive as the water barometer. It consists of an ordinary siphon barometer, in which the two vertical tubes are united by means of a long uniform horizontal tube, having a diameter considerably less than that of the main tubes. The instrument is filled in the same manner as the ordinary siphon barometer, except that a bubble of air or dilute acid is left in the narrow tube. For a given rise of pressure the absolute amount of mercury which passes from the shorter to the longer tube depends upon their diameters, and, as these are great in comparison with the tube uniting them, the motion of the bubble will be considerable in comparison with that of the summit of the mercurial column. He then exhibited a number of thin india-rubber balloons filled with water, which he has arranged with a view to illustrate the nature of jellies. By weighing at intervals one of these india-rubber bags, he has found that evaporation takes place from its surface. He is also examining a bag filled with salt water, and immersed in water in order to ascertain whether salt as well as water is capable of traversing the septum. Lastly, Prof. Guthrie exhibited a large series of Chladni's rings rendered permanent on cardboard by pressure, in contact with the plate which had been caused to vibrate, in a copying press. The sand and lycopodium were caused to adhere firmly by dilute gum.

THE SOCIETY OF TELEGRAPH ENGINEERS.

THE opening meeting of the Society for the present year was held at the Institute of Civil Engineers, 25, Great George-street, Westminster, on the evening of Wednesday, the 24th ult.

The chair at the opening of the meeting was taken by the retiring President, Mr. C. V. Walker, F.R.S., who introduced the new President, Professor Abel, F.R.S.

The Minutes of the previous meeting having been read and confirmed, the Secretary announced a list of no fewer than forty-six new candidates for election into the Society.

THE PRESIDENT then rose to deliver his Inaugural Address. Commencing by modestly disclaiming any pretence advanced by him for the high honour which had been conferred upon him, he stated that in his election as President to the Society he could only see that the members desired to recognise the high part which Chemical Science, with which his name was immediately connected, played in its relation to the applications of Electricity, and so strong, he urged, was his conviction that to this consideration he owed the privilege of addressing the members that evening, that he would now endeavour to illustrate some of the principal directions in which Chemical Science bears importantly on the work of the Telegraph Engineer. The investigations made by Dr. Matthiessen into the differences in the electrical conductivity of the various kinds of commercial copper were quoted as the first illustration of the subject. The very great variations found to exist in the copper wire employed in the early days of Submarine Telegraphy had been traced by Sir William Thomson and others to differences in the quality of the copper, but it was reserved for Dr. Matthiessen, into whose hands the Committee of the Privy Council for Trade and the Electric Telegraph Company entrusted the matter, to determine the influence exerted upon the conducting power of pure copper by the pure metalloids and metals known to be naturally associated with it. In illustration of the importance of the effects established by Matthiessen's experiments, it is interesting to note that the conducting power of pure copper was found not to be susceptible of increase by combining the metal with any other

substance, and that certain non-metallic elements, notably oxygen and arsenic, which occur as constant or very frequent impurities in the metal, exerted a very prejudicial influence upon its conducting power. For instance, the conductivity of pure galvano-plastic copper being fixed at 100, traces of arsenic in the metal, reduced its conductivity to 60, while the addition of 5 per cent. brought the conductivity as low as 6·5. The fusion of the pure metal in contact with air for a short time reduced the conductivity to 76.

The conductivity of pure copper Matthiessen found not to be so much affected by the presence of metallic as of non-metallic impurities, but it was shown to be considerably diminished by iron and tin. Thus the existence of 1·3 per cent. of tin in pure copper reduced its conductivity to 50·6, while with only 0·48 per cent. of iron its conductivity dropped as low as 36. Some specially interesting experiments of Matthiessen illustrated the cause of the good effects which had long previously been observed to be produced upon the working qualities of fine copper by the addition of small quantities of lead, and gave to the rule of thumb process a stamp of scientific accuracy. The existence of even 0·25 per cent. of lead in copper renders the latter so rotten that it cannot be drawn into wire, while even so minute a quantity as 0·1 per cent. of lead will render it unfit for wire-drawing. Hence the toughening and softening effects attained by a very small quantity of lead to refined copper must be ascribable to some special action of the material during the melting of the copper. The fact that only traces of lead were discovered by the analysis of copper so treated indicates that it must have combined with or removed some impurity which is detrimental to the toughness and ductility of the copper—this impurity was oxygen; and that the benefit of the effect of lead was due to the oxidising action received support from the beneficial influence of the metal when employed in casting operations with copper and gun-metal. A sample of pure copper after fusion in contact with air had a conductivity of 87·25; 0·1 per cent. was added to the metal, the two being fused together in a current of carbonic acid, and the conductivity was at once raised to 93, whilst the quantity of lead actually remaining in the copper was too minute to be determined; similar results were obtained with tin. The addition of 1·3 per cent. of tin reduced the conductivity 0·4, while the mixing together of 0·1 per cent. of tin raised the conductivity from 87·25 to 94·55, mere traces of tin only remaining in the copper. Matthiessen's well-known investigations into the resistances of alloys, which formed in the hands of the B.A. committee the most valuable aid for the determination of the standards of electrical measurement, were next quoted as an evidence of the aid brought by Chemical to Electrical and Telegraphic Science. The advances made of late years in the manufacture of iron, and still consequent upon the study of the theory of Metallurgical Processes, were not without their interest for Telegraphy, for the Government had, in consequence, raised the standard for the conductivity of iron-wire for telegraph purposes; but while Chemical Science has unquestionably contributed so much to the improvements in the *conductors*, no less may be looked from the labours of the chemist in the direction of dielectrics. The late Prof. Miller's investigations into the cause of the decay of gutta-percha and india-rubber are well known. The changes these gums undergo were examined by him, and he arrived at the same conclusion as other workers in the same direction had previously come to, that the changes in these gums resulting in the destruction of their insulating qualities was entirely due to oxidation through atmospheric influence, and that such oxidation was accelerated by the exposure of the material to light. He likewise pointed out that intermittent exposure to moisture, especially if solar light had access, rapidly destroys gutta-percha, while, as is well known, if kept continually immersed in water, it is practically indestructible. Even before exposure he found that "good" commercial gutta-percha contained as much as 15 per cent. of the products of oxidation, while no less than 2·5 per cent. of water was mechanically diffused through the sample. The mechanical process of manufacturing gutta-percha has doubtless been improved, but it does not seem that the corresponding improvement has been obtained in regard to the quality of the material as indicated by its chemical composition. The highest quality of sheet gutta-percha Professor Abel could obtain contained 12·7 per cent. of resinous matter, and 5 per cent. of water. The high proportions of mechanically enclosed water existing in sheet gutta-percha may be surprising, but there can be no question but that in the application of gutta-percha coatings to wire much greater pains should be taken to consolidate the material, and express enclosed water, than in the production of the sheet material; nevertheless, the amount of water enclosed by the insulated coatings of insulated wires is considerable. Two samples manufactured by the same firm, one in September and the other in November last, contained respectively 1·86 and 1·97 per cent. of water, whilst the sample of gutta-percha covered wire kept by him (Professor Abel) in a tank of water for at least ten years, being exposed to the air for brief periods at long intervals, and having been in the water eighteen months undisturbed previous to its examination, contained only 3·07 per cent. of water. Mastication there can be no doubt favours the oxidation of gutta-percha, so that the proportion of resin in the finished substance, and the mixing of the gum with a product detrimental to some of its most valuable properties as a dielectric for telegraph purposes, is to a considerable extent dependent upon the degree of completeness to which the mechanical separation of these impurities has been carried out.

Professor Abel entered minutely into the action of the vulcanising process, touched upon the aid which Chemical Science would bring upon the proper treatment of the batteries, in the investigation of the decay of timber, and in the proper manufacture of joints, and concluded by an interesting description of the difficulties which had been surmounted in the fuses with which his name was associated by the aid of Chemical Science.

Space, however, prevents our giving these in detail at present, and we will reserve for a future number the continuation of this most admirable address. At the close a hearty vote of thanks was accorded the new President on the motion of Mr. W. H. Preece, seconded by Major Bateman Champain.

After the following candidates had been elected: as Foreign Members: M. Edouard E. Blavier, M. Charles Bontemps, M. Fedeli Cardarelli, M. le Compte Theodore du Moncel, M. Joseph Lagarde, M. Jules Raymond; as Members: Mr. W. Wiese, Mr. Julius Terp, Mr. T. Skinner, Lieut. Rogers, R.N., Mr. Robert Punshon, Mr. Samuel Bidder; as Associates: Mr. Edward Almack, Mr. James Brown, Mr. George Clapperton, Mr. Charles Field, Mr. John Fraser, Mr. W. J. Fraser, Mr. Henry Goodwin—the meeting adjourned until the evening of Wednesday, the 14th inst., when Mr. W. H. Preece's paper on "Shunts" will be read.

The half yearly interest on the Debentures of the Western and Brazilian Telegraph Company, Limited, due 1st February, will be paid on and after that date at the Offices of the Company.

Electrical Science in Foreign Journals.

COMPTES RENDUS OF PARIS ACADEMY.

No. 25: 18TH DECEMBER, 1876.

On an Arrangement which permits of Reproducing, with the Syren, Foucault's Experiment of Stoppage of a Rotating Disc under the Action of an Electro-magnet. By M. BOURBOUZE.—(See note on p. 8.)

Practical Method of Testing a Battery Element. By M. LECLANCHÉ.

IN a figure he gives three curves representing the intensity, electro-motive force, and resistance. With the two former, and by a simple interpolation, a certain electro-chemical work being given, it is always easy to deduce the electro-motive force and intensity corresponding to the battery which has done this work. And the third curve representing variations of interior resistance can be calculated from the other two. (The third curve is an ascending one, the others descending.) M. Leclanché gives some results from varying the temperature. A Daniell couple (porous vase 12 ctm. in height) having acted for about three weeks, presented a resistance of about 835 metres of 4 mm. iron wire at the temperature + 10°. At 0° its resistance became = 1258m. At 4°, it was 1400m., and at — 6° the crystallisation was considerable, and the mass became pasty and almost solid. Between — 6° and — 10° it was hardly possible to measure the resistance: this went on increasing to about 20 kilometres. The sulphate of mercury couple presented like variations. At — 15° the resistance was = 20 to 25 kil. On the other hand the electro-motive force of the two couples varied little; it was weakened only a tenth, while the resistance was increased more than tenfold. With the peroxide of manganese battery, under the same variations of temperature, the resistance was hardly doubled (230m. at the beginning, to 422m. at — 18°); in ordinary freezing mixtures, a solution of sal-ammoniac does not even become pasty. The electro-motive force varied only about ½. A saturated solution of sulphate of copper solidifies at — 5°, of sulphate of zinc, at — 7°. These facts are interesting for telegraphy in the North of Europe.

No. 26: 27TH DECEMBER, 1876.

VOL. LXXXIV. No. 1: 3RD JANUARY, 1877.

No papers on electrical subjects.

No. 2: 8TH JANUARY.

Determination of the Polar Distance in Magnets. By M. BENOIT.

A MORE direct and general method than that of Pouillet is described.

Effects of Heat on Voltaic Circuits completed by an Electrolyte. By M. HELLESEN.

I. M. DU MONCEL has shown, that if one of the plates of an electrolyte is heated, there is a thermo-electric action causing a current to be developed, for which the heated plate forms the positive pole. This may become very strong, if the arrangement is such as to maintain the liquid round the two plates at very different temperatures. M. Hellesen connects two test-tubes near the top by a narrow tube, fills them with saturated solution of sulphate of copper, and fixes the copper electrode in one near the top, in the other at the bottom. Then he heats with a spirit lamp the test-tube whose electrode is near the top. A considerable current is obtained, and this electrode is quickly covered with copper. A simpler arrangement is, to fix on the edge of a vessel containing sulphate of copper solution a plate of copper curved so as to touch the surface of the liquid on one side, while on the other it presents, outside of the vessel, a surface which may be heated. The other electrode is immersed at the bottom of the liquid and connected by covered wire with the first; thus a strong current may be had. In these arrangements, the heated parts of the liquid tend to remain at the surface. Using magnetic helices of copper tubes, in which might be made to circulate cold water and super-heated steam, magnetic effects might be obtained (M. Hellesen thinks), which would explain the magnetic state of the globe in virtue of the unequal temperature of the seas. II. If an electrolyte be formed with the smoky flame of a paraffine candle, and a current be sent from 40 Leclanché elements or 30 of bichromate of potash, a strong arborescent deposit of carbon first forms at the end of the negative wire, the branches tending to rise in the direction of the flame, and to regain the positive wire. In a few seconds, carbonised threads, slightly arched, come to be deposited on the latter, also tending to rise with the flame. If you bring the two sets of deposits near each other, there pass a series of brilliant sparks. III. If for the short wire, connecting the anvil of the contact-breaker of a Ruhmkorff coil with the condenser, there be substituted a long wire wound parallely with another on a second bobbin, one may observe, when the ends of the second insulated wire are placed a short distance apart, a pretty strong spark, which can only come from the discharge of the condenser; for it can be produced with quite short wires not wound in helix, it is not influenced by a magnetic core placed in the second bobbin, and the inductor current of the apparatus does not pass into this second bobbin. On the other hand, it increases with the size of the condenser, and depends on the nature of the insulating plates of the latter; the strongest effects being with mica. This spark has in some cases had sufficient tension to traverse several millimetres of air, though only one Bunsen element (middle size), a coil of moderate dimensions, and a secondary wire of 10 metres, have been used.

MONITEUR SCIENTIFIQUE.

NOVEMBER AND DECEMBER, 1876.

M. Duchemin's Compass with Circular Magnets.

A NUMBER of reports testifying to the superiority of this instrument, as regards fixity of the line of poles, sensibility, and mechanical stability.

MONATSBERICHT OF BERLIN ACADEMY.
AUGUST, 1876.

On the Electric Discharge in Solid Insulators. By M. HOLTZ.

AFTER describing his apparatus, the author considers the striking distance, in its relation to density, to quantity, to polarity, to the mass, and to special formations of the insulating body; he then describes the phenomena of the spark and the brush obtained in solid insulators; and lastly, the action on the insulator. The paper contains many interesting facts.

On the Auxiliary Conductors of Simple and Compound Influence-Machines. By M. HOLTZ.

JOURNAL DE PHYSIQUE.
NOVEMBER, 1876.

On the Distribution of Magnetism in Cylindrical Bars. By M. BOUTY.

M. BOUTY concludes that there is an almost absolute independence between the temporary and the permanent magnetisation; and this may be attributed, at least in part, to a difference of origin —for example, a veritable magnetic heterogeneity of steel.

On the Heat Liberated by Mixture of Sulphuric Acid and Water. By M. PFAUNDLER.

DECEMBER.

No (original) paper on electrical subjects.

ANNALES DE CHIMIE ET DE PHYSIQUE.
NOVEMBER, 1876.

On Electric Condensation. BY M. MOUTIER.

HE studies, from the theoretical point of view, electric condensation as recently described in the *Annales* by M. Gaugain.

Correspondence.

TELEGRAPHIC PROGRESS IN 1876.

WE have received from Mr. George Eveleigh a letter with reference to the article under the above heading, which appeared in the last number of the Journal, with reference to the statement made as to Clamond's form of Thermo-electric pile. Mr. Eveleigh states that it is *not* almost banished, but that it is "on the eve of re-appearing with a new Company, and under the auspices of of men eminent in the electrical world, well versed in science, and those branches of trade in which electricity is the very life of their existence, and that although as a result of the violent tests to which the said apparatus was last year justly subjected, some slight defects were detected, yet ample means have since been provided to supply its previous deficiences."

We are pleased to hear this, and as soon as the Clamond does re-appear we shall have much pleasure in again studying its working, and endeavouring to assign a value to the "ample means" referred to. At the same time, we believe the statement which appeared upon the subject in our last number contained the facts of the case so far as 1876 was concerned. Clamond's Pile was, we understood, tried experimentally both by the Exchange Telegraph Company and the Postal Telegraph Department; in each case it gave way under the test of continued trial, and its then form did seem to be almost banished from the field of competition.

The other portion of Mr. Eveleigh's letter relates to matters of a personal nature in connection with the Promotion and Directorate of the late Clamond Company, which cannot well be admitted in the pages of this Journal.

R. WERDERMANN.—We regret we cannot insert your letter. It simply questions the accuracy of our own information, without imparting any fresh facts or narrating new experience. If you can adduce facts in support of your statements, they shall have all consideration. We cannot admit personal matters into our columns.

PATENTS.

14. SIR J. ANDERSON and W. H. ASH.—"Electric telegraphs."—1st January, 1876.

47. B. SMITH.—"Improvements in signalling in opposite directions by the same wire simultaneously."—5th January.

52. F. DARKIN.—"Improved electric battery."—5th January. (A communication.)

128. C. BONDI.—"Signalling and telegraphing on railways and tramways."—12th January.

162. W. HARLING.—"A new or improved electric disc or bell instrument for railway signalling, applicable in part also to other purposes."—14th January.

288. L. JANSE.—"An improved direction indicator to be used as a compass otherwise."—25th January.

367. F. LE B. BEDWELL.—"Improved means and apparatus for connecting submarine telegraph cables with light or other ships or floating stations or buoys."—29th January.

386. A. M. CLARK.—"Dynamo-electric machines."—31st January. (A communication.)

421. G. T. BOUSFIELD.—"Preservation of telegraph and other wood-posts."—2nd February. (A communication.)

433. J. A. FAHIE.—"Improved relay or electro-magnet, which may be employed also in any instrument or contrivance where relays or electro-magnets with counteracting springs are used."—3rd February. (A communication.)

492. C. W. HARRISON.—"Application of magnetism for the promotion, restoration, and preservation of health."—7th February.

524. W. R. LAKE.—"Galvanic batteries."—9th February. (A communication.)

567. A. J. HADDAN.—"Electro-magnetic type-distributor."—12th February. (A communication.)

599. J. CURREN.—"Construction of electric indicators."—14th February.

610. G. WEATHERS.—"A rotatory electric light."—15th February.

642. W. R. LAKE.—"Mariners' compasses."—10th February. (A communication.)